The effects of Stress on Visual Selective Attention: The Moderating Role of Personality Factors

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Abstract: This study investigated the effects of stress on visual selective attention according to the five-factor model of personality (FFM). The sample was selected with respect to neuropsychological control variables by multistage cluster sampling from unmarried male students of Tehran universities. On this account, there were 140 subjects equally distributed in 7 groups including six experimental groups and one control group. Subjects in experimental groups administered cognitive stressful tasks and then their visual selective attention was assessed. The control group's visual selective attention was assessed without administrating cognitive stressful tasks. Sum of errors in counting and classification were assigned as visual attention indexes. Results indicated that stress increased significantly in both counting and classification errors ($p<0.001$). In addition, all experimental groups aggravated the effect of stress on both counting error and classification error ($p<0.05$) significantly, except for E, the group with high levels of extraversion that reduced and inverted that effect ($p<0.05$) significantly. These results revealed that stress reduces the visual selective attention on neutral stimuli. Although, N, O, A, and C intensify the negative effect of stress on visual selective attention, E reduces and inverts this negative effect.

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1. Introduction

Among brain executive functions are attentional mechanisms, especially selective attention (Razza & Blair, 2009; Fournier-Vicente, Lariguarderie & Gaonsc'h, 2008; Baddeley, 1996). Attention is defined as "the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought … it implies withdrawal from some things in order to deal effectively with others, and is a condition which has a real opposite in confused, dazed, scatterbrained state which … is called distraction" (James, 1890/1983).

The ability to attend selectively to a bunch of information while ignoring other information in favour of them is called selective attention, which is an important function in central executive system (Kane & Engle, 2000; Baddeley, 1996). In other words, it can be said that selective attention is the ability to avoid interference of non-relevant-to-task information with target information selection; either distracting information act as a prepotent response or a non-prepotent response (Fournier-Vicente, Lariguarderie & Gaonsc'h, 2008).

Selective attention is divided to visual and auditory attention. Visual attention determines which visual objects or details are applied to compute the location of the saccadic endpoint (Cohen, Schnitzer, Gersch, Singh, & Kowler, 2007; Vishwanath & Kowler, 2003). At any given time, we are able to process only a portion of the vast amount of visual information in our environment (Fuller, Park & Carrasco, 2009). Attending to the chosen target ensures that the eye movements will be accurate, and the line of sight will not be drawn to irrelevant, unwanted objects or locations nearby (Gersch, Kowler, Schnitzer & Dosher, 2009). Visual attention is essential for secondary organization of cortex and preparation for higher cortical and cognitive processes (Eysenck & Keane, 2000).

The field of Cognitive and Behavioural Neuroscience has recently witnessed an explosion of studies investigating the processing of the visual system mechanisms such as eye region and gaze direction in various tasks like social situations because of the complexity of the higher cortical functions, the underlying neural systems subtending these processes are not well known yet (Itier & Batty, 2009). This explosion is due to the importance of visual processing priority in brain.

It appears that if any factor can influence visual attention, then can influence all screening processes of visual inputs and therefore alter visual perception and processing. Moreover, provided that a factor is potential to increase visual attention span, it might consolidate abilities related to visual processing; in reverse, in case a factor results in reduction in visual attention span, it may reduce the efficiency of the abilities, which are related to visual processing. Affective and emotional responses may deviate attention and influence EFs (Ghom, Baumann & Sniezek, 2001).

In the field of EFs, many studies investigated a variety of factors that may have role in qualitative and quantitative changes in these processes. There is conclusive evidence that attention is preferentially allocated to stimuli that people appraise as threatening or potentially dangerous (for a review, see Bar-Haim et al., 2007). These findings have been considered as evidence for the existence of a ''fear module'' that guides attentional orienting so that it allows the rapid detection of potential dangers in the environment (Öhman, Flykt, & Esteves, 2001). Stress is the central part of any threat and in fact, one of the major domains that have been studied is the effect of stress on attentional functions (Passer & Smith, 2001). Stress is a multiple process that occurs in response to our life events or situations and acceptance of any kind of stress needs active adaptation (Sadock & Sadock, 2007).

Stress leads to activation of the sympathetic nervous system (SNS) and an increased activity of the hypothalamic–pituitary–adrenal axis (HPAA; de Kloet, Joels, & Holsboer, 2005). The first rapid response of the SNS is mediated via the catecholamines, adrenaline and noradrenaline. The second relatively slower stress response consists of activation of the HPAA and leads to the release of glucocorticoids from the adrenal cortex. These stress hormones influence central nervous system (CNS) especially those regions dealing with emotional processing (amygdale and hippocampus) and make the individual ready to respond to stress appropriately (Reagan, Grillo, & Piroli, 2008). Because both of these structures have the major role in emotional and cognitive processing and processing biases of CNS and are major centres of glucocorticoids action in CNS, It appears that stress influences attentional systems via these structures. In addition, evidence have supported that stress negatively has an impact on attentional mechanisms (e.g., Schoofs, Preuβ, & Wolf, 2008).

Another filed that can influence the performance of attentional process is related to those constructs which deal with the internal factors: the top-down processes. Top-down processing involves the generation of schemas by the higher cortical structures functioning and these schemas are sent down the nervous system for comparison with the incoming stimulus. Top-down processing is also sometimes referred to as schema-driven or conceptually driven processing (Groome, et al., 2006). In other words, it can be inferred that our previous experiences have significant role in our attentional processes. The Holistic outward appearance of centralized system of cognition and cortical processing is personality. Personality could be defined as the dynamic organization of psychophysiological systems inside the individual that determines index behaviours and thoughts (Allport, 1961).

One the recent and influential models of inspecting and studying the personality is Five-Factor Model of personality (FFM) (Zawadzki, & Strelau, 2010). FFM have had significant influences on personality psychology in recent decades (Rolland, 2002). This model, partially due to vast researches done to obtain its validity, is now a reference model in hierarchical models of personality (Cattell, 1996). Even superseding models of FFM has just dealt with integrating, regrouping or adding some extra dimensions to it (Rolland, 1996).

According to the mentioned issues, recently there is strong evidence that indicates some relations between stress and deficits in attentional processes, but no research has been conducted in order to show the exact causality relation between these two domains yet. In addition, no research has been conducted to investigate the trilateral relations of visual attention, stress & personality factors. Furthermore, with respect to reported studies, the roles of personality factors in the relations between stress and attention has not been clarified through a purified and causal relation and previous studies about the mentioned variables have been conducted via Correlational and ex-post facto methods and not had not been done to investigate these three variables altogether. With regard to the lack of information in this area, this study is devoted to investigate the effects of stress on visual selective attention according to the moderating role of personality factors.

2. Method

2.1. Study design

The design of the present study was experimental and post-test with control group. The independent variable was stress, which was induced through the administration of cognitive stressor tasks that will be announced in measures section. The dependent variable was visual selective attention. The dependent variable was measured in two ways: counting the subjects' errors in categorizing the presented images into classes (*Classification error*), and subjects' errors in counting the stimuli presented in each image (*Counting error*).

2.2. Control variables

Because of the sensitivity of executive functions, especially attentional mechanisms, to a variety of variables, a wide range of control variables are considered in this study. These control variables include age (between 21 and 36); gender (male); religion (Islam); personality factors (assessed by using the *NEO-PI-R*); education (at least BA/BS student); handedness (right-hander) and eye dominance (right-eyed), checked by neuropsychological screening test (Lezak, Howieson, Loring, Hannay, & Ficsher, 2004); Marital status (single and not married); residence (living in Tehran); having no pathological history of CNS; having no pathological history of visual system; having no kind of colour-blindness (Assessed by *Ishihara Colour-Blindness Test*); having no history of Visual agnosia; having no history of encephalitis and other CNS diseases; having no current usage of medicine that affects visual & attentional systems; no history of drug dependency and/or drug abuse; having no current drug dependency and/or drug abuse; having no refraction defections; having no history of and/or current psychotic disorders (Schizophrenia, psychotic depression and etc.); and having no history of and/or current psychological and/ or psychiatric disorder that affects attention. All the above issues were assessed via using a structured clinical interview and neuropsychological screening checklist designed by researchers. In addition, all the experiment phases were done between 3 and 7 pm in order to control the durinal rhythms fluctuations.

2.3. Participants

The population consisted of all male right-hander & right-eye BA/BS & upper students in Tehran's state universities including nearly 8000 students. According to Heponiemi (2004) and Heponiemi, et al. (2003) the developmental and maturational aspects of neurological characteristics of people aged between 21 and 36 is nearly similar. Hence, in this study this age range has been chosen (mean age of sample group was 26 years & 7 months, SD= 3 years and 8 months). Sample group consisted of six experimental and one control group. Each group consisted of 20 subjects. Subjects were chosen by random multi-session sampling in which at first universities & faculties were chosen randomly and then in target groups, target people were chosen randomly according to control variables.

2.4. Procedure

Using multistage cluster sampling method and administrating the neuropsychological screening checklist within the structured clinical interview on primary sample, control variables were checked. In the next phase, people who met the research control criteria administered the NEO-PI-R in one session.

The NEO-PI-R scores calculated and 200 individuals, whose scores in all five factors of personality were at the mean range, were chosen. Among those, 40 subjects were chosen randomly (target subjects) and randomly assigned to two equal 20 subject groups: *Original* and *Control* groups. The original group was organized in order to assess the role of stress with respect to controlling the moderating effects of personality factors.

One hundred individuals, whose scores in Neuroticism were higher than mean range while their scores in four other factors were in the mean range, were chosen. Among them, 20 subjects were chosen randomly (target subjects) and placed in *N experiment group*. This procedure was replicated for the rest of the factors so that five equal experimental group were made (N, E, O, A & C). Hence, our experimental study included six experiment groups (N, E, O, A, C, & Original) and one control group.

Cognitive stressor tasks were administered on 6 experiment groups and then 44 complex visual stimuli presented by tachistoscope to each subject in order to assess their visual selective attention. Each complex visual stimulus included colourful images of living or lifeless beings. The number of images in each stimulus was between three and seven and in any visual stimulus; there were just one specific object. The subject should say the name (classification) and the number (counting) of the objects in each stimulus. Each stimulus presented in 0.150 seconds (conscious attention threshold; Kandel, Schwartz & Jessel, 2000).

The control group subjects did not administer cognitive stressor tasks while their visual selective attention was assessed as well as the experiment groups. The errors of subjects of the experimental and control groups in counting the objects and their errors in naming the objects in all the stimuli were recorded. To regard moral ethics, all the subjects filled out written subscriptions.

2.5. Measures

2.5.1 Cognitive stressor tasks

In order to induce experimental stress and having no harmful side effects on subjects, it is preferred to use a set of cognitive tasks that previously proved to be mentally stressful individually (Cramer, 1991) and as set (Cramer, 2003; Shedler, Mayman, & Manis, 1993; Mandler, Mandler, Kremen, & Sholiton, 1961).

At first subjects were asked to sit down in a silent and relaxed manner for 10 minutes (adaptation

Period). The stressful task set consists of 10 stages (Cramer, 2003; Shedler, Mayman, & Manis, 1993):

1. One mental arithmetic stage: In this task, subject should count down from 609 in 13 intervals continuously in one minute. This task was described to subject as a mental ability task and speed and accuracy during the task will be emphasized. The subject was asked to make his/her maximum effort. After 30 second, disregard to subject's performance, the subject was asked to perform faster.
2. Three phrase association stages: In this procedure, three sorts of sentences were presented to subjects. Each sort consists of five sentences. Each sentence was written in a separate card. Subject will be told "now I will show you some cards and a sentence is printed on each card. Please read out each sentence, with load and clear voice, and then say the first thing that comes to your mind". After presenting each sort subject will have a two-minute break.
3. Six TAT card presentation tasks: In order to induce experimental stress to subjects, six cards were chosen from TAT cards (Murray, 1943; Morgan, & Murray, 1935). These cards are 18GF, 8GF, 8BM, 10, 15, & 2 and were presented to subjects separately. Subjects should make a story about each card according to TAT manual.

2.5.2. Ishihara Colour-Blindness Test:

In order to screen subjects to have no colour-blindness problems, the Ishihara Colour-Blindness test was used. This test is a booklet with 38 colourful figures and by administrating the instructions the experimenter can find any kind of colour-blindness problems (if exists).

2.5.3. Neo-PI-R:

The NEO-PI-R has 240 items and measures Big Five personality factors, as well as 30 facets (six by dimension), although they were not used in the present study. The construct validity of the NEO PI-R, and its previous version—the NEO-PI–, has been clearly demonstrated by the replicability of its five-factor structure in several languages and cultures (Caprara, et al., 2001; Katigbak, Church, & Akamine, 1996). The reliability coefficients oscillate between 0.86 and 0.92 (McCrae, & Allik, 2002; Costa & McCrae, 1992). In the study, the Persian version of NEO-PI-R administered that has reliability coefficients within 0.56 and 0.92 (Garrousi Farshi, 2001).

2.5.4. Neuropsychological screening checklist:

To apply the control variables in each subject and due to the wide range of control variables, all the control variables were put in a checklist (Neuropsychological screening checklist) by researchers and the interviewers used it to assess subject.

2.5.5. Tachistoscope:

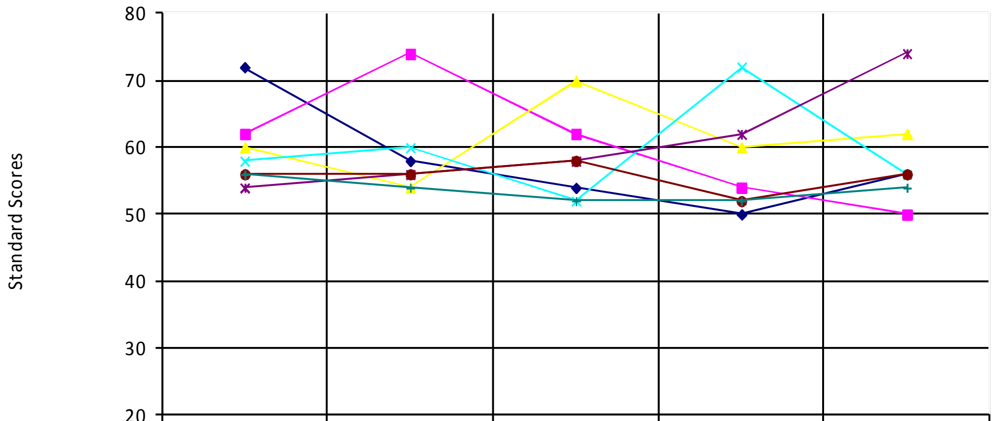
This apparatus enables researchers to present visual stimuli in identical conditions between 0.0001 and 1 second and upper and prepare the conditions to investigate monocular and binocular information processing. Candle power, stimulus distance and presentation times are controllable. This apparatus was used in to present the visual stimuli.

2.6. Data analysis

After the experimental administration phase, the gathered data analyzed with SPSS 17. To compare the error score between experiment and control groups, independent samples ANOVA and Tukey HSD post hoc test were used.

3. Results

The personality profiles of all study groups are presented in figure 1 (standard scores).



	N	E	O	A	C
N	72	58	54	50	56
E	62	74	62	54	50
O	60	54	70	60	62
A	58	60	52	72	56
C	54	56	58	62	74
Original	56	56	58	52	56
Control	56	54	52	52	54

N E O A C Original Control

Figure 2. Standard scores of personality profiles of subjects

In order to compare the experiment groups' results with each other, the analysis of variance (ANOVA) was used. The ANOVA results showed that F ratio in *Counting Error*, was 57.621 (d.f. =6 and sig. =.000) and in *Classification Error* was 45.790 (d.f. = 6 and sig. =.000). Therefore, ANOVA results were significant in both error categories (Table 3).

Table 3: ANOVA results

		Sum of Squares	df	Mean Square	F	Sig.
Error of Number (Counting error)	Between Groups	5041.486	6	840.248	57.621	.000
	Within Groups	1939.450	133	14.582		
	Total	6980.936	139			
Error in Classification	Between Groups	4417.986	6	736.331	45.790	.000
	Within Groups	2138.700	133	16.080		
	Total	6556.686	139			

According to significance of F ratio in ANOVA results, Tukey HSD post hoc test was administered in order to study and determine which groups' differences are significant. The comprehensive results of Tukey HSD post hoc test are presented in table 4.

In table 4, Tukey HSD results show that in *Counting Error*:

1. The *N group* got more significant scores than other groups including *E*, *O*, *A*, *C*, *Original* and *Control* (sig. =.000).
2. The *E group* got less significant scores than *N* (sig. =.000), *O* (sig. =.000), *A* (sig. =.000), *C* (sig. =.000) and *Original* (sig. = .006) groups significantly, but had no significant differences with Control group.
3. The *O group* got more scores than *E* (sig. =.000) and *Original* (sig. =.032) and *Control* (sig. =.000) groups and less than *N* group (sig. =.000) significantly.
4. The *A group* got more scores than *E* (sig. =.000), *Original* (sig. =.003) and *Control* (sig.

=.000) groups and less than *N* group (sig. =.000) significantly.

5. The *C group* got more scores than *E* (sig. =.000), *Original* (sig. =.014) and *Control* (sig. =.000) groups and less than *N* group (sig. =.000) significantly.
6. The *Original group* got more scores than E (sig. =.006) and Control (sig. =.000) groups and less than N (sig. =.000), A (sig. =.003) and C (sig. =.014) groups significantly.

In *Classification Error,* it revealed that:

1. The *N group* got more significant scores than other groups including *E*, *O*, *A*, *C*, *Original* and *Control* (sig. =.000).
2. The *E group* got less significant scores than *N* (sig. =.000), *A* (sig. =.000), *C* (sig. =.000) and *Original* (sig. =.006) groups significantly, but had no significant differences with *O* and *Control* group.
3. The *O group* got more scores than *E* (sig. =.000), Original (sig. =.050) and *Control* (sig. =.000) groups and less than *N* (sig. =.000) group significantly.
4. The *A group* got more scores than E (sig. =.000), Original (sig. =.001) and Control (sig. =.000) groups and less than N (sig. =.007) group significantly.
5. The *C group* got more scores than E (sig. =.000), Original (sig. =.001) and Control (sig. =.000) groups and less than N (sig. =.005) group significantly.
6. The *Original group* got more scores than E (sig. =.000) and Control (sig. =.000) groups and less than N (sig. =.000), O (sig. =.050), A (sig. =.001) and C (sig. =.001) groups significantly.

Table 4: Multiple comparisons of Tukey HSD results

Dependent Variable	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Upper Bound	Lower Bound
Error of Number (Counting Error)	N	E	18.500(*)	1.208	.000	14.88	22.12
		O	10.900(*)	1.208	.000	7.28	14.52
		A	9.350(*)	1.208	.000	5.73	12.97
		C	9.900(*)	1.208	.000	6.28	13.52
		ORIGINAL	14.050(*)	1.208	.000	10.43	17.67
		CONTROL	19.050(*)	1.208	.000	15.43	22.67
	E	N	-18.500(*)	1.208	.000	-22.12	-14.88
		O	-7.600(*)	1.208	.000	-11.22	-3.98
		A	-9.150(*)	1.208	.000	-12.77	-5.53
		C	-8.600(*)	1.208	.000	-12.22	-4.98
		ORIGINAL	-4.450(*)	1.208	.006	-8.07	-.83
		CONTROL	.550	1.208	.999	-3.07	4.17
	O	N	-10.900(*)	1.208	.000	-14.52	-7.28
		E	7.600(*)	1.208	.000	3.98	11.22
		A	-1.550	1.208	.858	-5.17	2.07
		C	-1.000	1.208	.982	-4.62	2.62
		ORIGINAL	3.150(*)	1.208	.032	-.47	6.77
		CONTROL	8.150(*)	1.208	.000	4.53	11.77
	A	N	-9.350(*)	1.208	.000	-12.97	-5.73
		E	9.150(*)	1.208	.000	5.53	12.77
		O	1.550	1.208	.858	-2.07	5.17
		C	.550	1.208	.999	-3.07	4.17
		ORIGINAL	4.700(*)	1.208	.003	1.08	8.32
		CONTROL	9.700(*)	1.208	.000	6.08	13.32
	C	N	-9.900(*)	1.208	.000	-13.52	-6.28
		E	8.600(*)	1.208	.000	4.98	12.22
		O	1.000	1.208	.982	-2.62	4.62
		A	-.550	1.208	.999	-4.17	3.07
		ORIGINAL	4.150(*)	1.208	.014	.53	7.77
		CONTROL	9.150(*)	1.208	.000	5.53	12.77

	ORIGINAL	N	-14.050(*)	1.208	.000	-17.67	-10.43
		E	4.450(*)	1.208	.006	.83	8.07
		O	-3.150(*)	1.208	.032	-6.77	.47
		A	-4.700(*)	1.208	.003	-8.32	-1.08
		C	-4.150(*)	1.208	.014	-7.77	-.53
		CONTROL	5.000(*)	1.208	.001	1.38	8.62
	CONTROL	N	-19.050(*)	1.208	.000	-22.67	-15.43
		E	-.550	1.208	.999	-4.17	3.07
		O	-8.150(*)	1.208	.000	-11.77	-4.53
		A	-9.700(*)	1.208	.000	-13.32	-6.08
		C	-9.150(*)	1.208	.000	-12.77	-5.53
		ORIGINAL	-5.000(*)	1.208	.001	-8.62	-1.38
Error in Classification	N	E	15.800(*)	1.268	.000	12.00	19.60
		O	6.250(*)	1.268	.000	2.45	10.05
		A	4.600(*)	1.268	.007	.80	8.40
		C	4.750(*)	1.268	.005	.95	8.55
		ORIGINAL	10.000(*)	1.268	.000	6.20	13.80
		CONTROL	16.200(*)	1.268	.000	12.40	20.00
	E	N	-15.800(*)	1.268	.000	-19.60	-12.00
		O	-9.550(*)	1.268	.000	-13.35	-5.75
		A	-11.200(*)	1.268	.000	-15.00	-7.40
		C	-11.050(*)	1.268	.000	-14.85	-7.25
		ORIGINAL	-5.800(*)	1.268	.000	-9.60	-2.00
		CONTROL	.400	1.268	1.000	-3.40	4.20
	O	N	-6.250(*)	1.268	.000	-10.05	-2.45
		E	9.550(*)	1.268	.000	5.75	13.35
		A	-1.650	1.268	.850	-5.45	2.15
		C	-1.500	1.268	.899	-5.30	2.30
		ORIGINAL	3.750(*)	1.268	.050	-.05	7.55
		CONTROL	9.950(*)	1.268	.000	6.15	13.75
	A	N	-4.600(*)	1.268	.007	-8.40	-.80
		E	11.200(*)	1.268	.000	7.40	15.00
		O	1.650	1.268	.850	-2.15	5.45
		C	.150	1.268	1.000	-3.65	3.95
		ORIGINAL	5.400(*)	1.268	.001	1.60	9.20
		CONTROL	11.600(*)	1.268	.000	7.80	15.40
	C	N	-4.750(*)	1.268	.005	-8.55	-.95
		E	11.050(*)	1.268	.000	7.25	14.85
		O	1.500	1.268	.899	-2.30	5.30
		A	-.150	1.268	1.000	-3.95	3.65
		ORIGINAL	5.250(*)	1.268	.001	1.45	9.05
		CONTROL	11.450(*)	1.268	.000	7.65	15.25
	ORIGINAL	N	-10.000(*)	1.268	.000	-13.80	-6.20
		E	5.800(*)	1.268	.000	2.00	9.60
		O	-3.750(*)	1.268	.050	-7.55	.05
		A	-5.400(*)	1.268	.001	-9.20	-1.60
		C	-5.250(*)	1.268	.001	-9.05	-1.45
		CONTROL	6.200(*)	1.268	.000	2.40	10.00
	CONTROL	N	-16.200(*)	1.268	.000	-20.00	-12.40
		E	-.400	1.268	1.000	-4.20	3.40
		O	-9.950(*)	1.268	.000	-13.75	-6.15
		A	-11.600(*)	1.268	.000	-15.40	-7.80
		C	-11.450(*)	1.268	.000	-15.25	-7.65
		ORIGINAL	-6.200(*)	1.268	.000	-10.00	-2.40

* The mean difference is significant at the .05 level.

4. Discussion

This study aimed to examine the effects of stress on visual selective attention according to five dimensions of personality in FFM. Due to the comprehensive design and varied domains of the results, they will be discussed individually respectively.

4.1. The effect of stress on visual selective attention

Findings showed that stress reduced visual selective attention significantly (p<.001) in counting errors and classification errors (p<.0001) significantly (the comparison of Original group in which all subjects had personality profiles in mean range and administered stressful tasks with Control group).

The results of the present study, that seems to be the first experimental study to investigate the effects of stress on visual elective attention in such a pure manner and wide range of control variables, is similar to previous studies in this area. With respect to controlling personality and other environmental and individual factors, even religion and the time of administration according to durinal rhythms, it can be concluded that the significant difference between original and control group is because of stress induction.

Hsu & Jeng (2008) and Ziaei & O'Boyle (1992) in their research on infants found that those infants who had less distress in laboratory got better results in visual attention tasks from others.

A central assumption of Allport's view is that the deployment of attention is influenced by goals. A goal can be understood as the mental representation of a desired end state that differs from the current state of an individual (Fishbach and Ferguson, 2007). Several theories posit that the activation of a goal automatically directs attention to match stimuli in the environment (e.g., Soto et al., 2008; Johnson et al., 2006). It is likely that the strength with which a goal is pursued influences how much attention is deployed to goal-relevant stimuli (Förster, Liberman, & Freidman, 2007). Therefore, the appraisal of the individual of the importance of upcoming event appears to be most determinant factor of allocating attention and the results of the present study have proved it.

It appears that there is a mutual relation between stress and visual selective attention. From one side, stress occupies attentional span to stressful events and situations and diverts visual selective attention from current unrelated-to-stress tasks through an evolutionary choice of threat avoidance. On the other hand, the higher cortical functions of cognitive processing, especially selective attention, inherently biased to process stress related stimuli prior to neutral and positive ones. Hence, the natural result should be a significant reduction in selectively attending to neutral tasks in the presence of stress.

4.2. The effect of stress on visual selective attention according to Neuroticism (N)

The results showed that the negative effect of stress on visual selective attention was intensified by high levels of *N* significantly (comparing N experimental group with Original group; p<.0001). The results in this section are in line with previous studies about the negative effects of *N* on attentional processes and amplifying the stress effects on higher cortical functions.

Fox, Cahill, & Zougkou, 2010 recently have found that for the laboratory-based stressor, higher baseline levels of self-reported *N* did predict a greater change in the subjective response to stress. In addition, reduced attention for positive material at the preconscious level at baseline was also associated with a larger subjective response to a laboratory-based stressful situation.

N has been associated with exaggerated threat perception (Bishop, 2008) and it can be interpreted as high levels of *N* which can lead to more perceived stress in individuals. O'Donovan, et al. (2010) in their recent study found that clinically anxious individuals have lower levels of morning cortisol and higher levels of the pro-inflammatory cytokine IL-6. In fact, the pattern of lower morning cortisol and elevated IL-6 that anxious participants exhibited in the study resembles the pattern previously observed in association with chronic stress (Miller et al., 2007; Kiecolt-Glaser et al., 2003). In other words, *N* appears to predispose people to perceive and experience more stressful events and because this factor is temporally stable (Terracciano, Costa, & McCrae, 2006) high *N* scores end in high levels of chronic stress throughout the life. Hence such people's selective attention processes will be disturbed more. In this point of view, *N* can be seen as a great facilitator of negative effect of stress on visual selective attention.

4.3. The effect of stress on visual selective attention according to Extraversion (E)

The results showed that the negative effect of stress on visual selective attention was reduced and neutralized by high levels of *E* significantly (comparing E experimental group with Original group; p<.006).

These findings are in line with previous findings that *E* can divert and reduce negative effects of stress on brain functioning. Several functional magnetic resonance imaging studies reported correlations between *E* and increased activation of the rostral anterior cingulate cortex (rACC) during a number of cognitive and emotional tasks (Haas, et al., 2006; Eisenberger, Lieberman, & Satpute, 2005;). This region of the brain receives mass dopaminergic inputs (Gaspar, et al., 1989), projects to the striatum and the ventral tegmental area (Haber, et al.,2006; Öngür & Price, 2000), indicates activity increases in response to dopamine-increasing drugs (Udo de Haes, et al., 2007; Völlm et al., 2004) and has been associated with subjective reports of pleasantness in response to various stimuli from different modalities (Grabenhorst, Rolls, & Bilderbeck, 2008; Rolls, Grabenhorst, & Parris, 2008; Rolls, Kringelbach, & de Araujo, 2003). Therefore, it appears that *E*, as an individual predisposition, tends to compile a wide range of stimuli to pleasant ones.

In a most recent study, Suslow et al. (2010) investigated the brain automatic response to facial emotion and found that the Implicit Association Test (IAT) *E* was negatively correlated with automatic reactivity of the caudate head, thalamus, and inferior frontal cortex to sad faces. In addition, NEO-FFI *E* was negatively correlated with response of the inferior frontal cortex and putamen to sad faces. These results show that *E* has an opposite role against negative emotions and stress effects in cortical and subcortical structures and high levels of *E* reduces the neuronal reactions to stress. Hence, it can be concluded that *E* is actually enhances the visual attentional performance under stressful circumstances. However, this positive effect was not significantly more than people in neutral situation and this issue should be investigated in future studies specifically.

4.4. The effect of stress on visual selective attention according to Openness to experience (O)

The results showed that high levels of *O* intensified the negative effect of stress on visual selective attention significantly (comparing O experimental group with Original group; p<.05).

The results of the present study are in line with previous studies. In some studies (e.g., Toyosawa, & Karasawa, 2004; Shiloh, Salton, & Sharabi, 2002; Handley, Newstead, & Wright, 2000; Pacini, & Epstein, 1999) it has been revealed that people with high openness without the presence of cognitive biases, such as stress, show high levels of performance in rational functions. Other studies (e.g., Van Hiel, & Mervielde, 2005; Heaven, & Bucci, 2001; Lippa, & Arad, 1999) show that *O* is related to prejudicial behaviours inversely.

O is the hardest conceptual factor in the FFM to commentators (Donnellan, Conger, & Bryant, 2004; McCrae, & Costa, 1997). Researchers found that *O* has a positive powerful relation with divergent thinking (Chamorro-Premuzic & Reichenbacher, 2008; King, Walker, & Broyles, 1996; McCrae, 1987) and fluid intelligence (Silvia, & Sanders, 2010; Chamorro-Premuzic & Furnham, 2006; Silvia, 2006). This means the high scores in *O* lead to curiosity about internal and peripheral environment, sharing knowledge with others (Matzler, et al., 2008), experiencing positive and negative emotions more intense (Costa, & McCrae, 1992) and a greater enthusiasm to learn and explore new issues (e.g., Kashdan & Steger, 2007; Feist & Brady, 2004; Renninger, 2000; Barrick, & Mount, 1991). Therefore, it appears that two events are obvious in individuals high in *O* during exposure to stressful events:

1. These people experience more intense emotions of distress than people with moderate or low levels of openness.
2. Because of more genetic predisposition of these people to divergent thinking and curiosity to new issues than people with moderate or low levels of *O*, in stressful situations their attentional and processing mechanisms are biased to the emotional state and try to investigate and bring up these internal and external states with others.

Thereupon, it seems that the natural consequence of such condition is a significant reduction in attentional and processing capacity during stressful events, because most of the capacity of conscious selective attention of individuals high in *O* is devoted to stress and its effect on individuals.

4.5. The effect of stress on visual selective attention according to Agreeableness (A)

The results revealed that the negative effect of stress on visual selective attention was intensified by high levels of *A* significantly (comparing A experimental group with Original group; p<.0003).

Researches about *A* are few and divergent in findings. *A* is a measure of how much a person wants to be liked by other people (Pothos, et al, 2010) and previous research has shown that agreeable individuals specifically strive for (and thus likely value) communion (Barrick, Stewart, & Piotrowski, 2002). In addition, it seems that people high in *A* present themselves in ways that make them appear more attractive engage in behaviours that make their appearance more pleasing (Meier, et al., 2010). Moreover, *A* has emerged as a significant predictor of pro-environmental values (Hirsh & Dolderman, 2007) and Individuals who are more empathic and less self-focused appear more likely to develop a personal connection with nature (Hirsh, 2010). One logical conclusion of these findings might be that during stressful situations agreeable people tend to show off more their intrinsic traits and therefore attend more to peripheral and interpersonal events rather than their entrusted tasks, in order to reduce their stress, and fail in visual selective attentions tasks.

Another reason for negative effect of high levels of *A* on visual selective attention might be due to the manner in which agreeable individuals process information. Mischel and Shoda's (1998, 1995) cognitive–affective system theory of personality conceives traits to be related to information processing mechanisms. In a series of laboratory studies, Tobin, et al. (2000) examined individual differences in emotional information processing and found that agreeable individuals experienced more emotion in situations consequential for relationships. Such heightened experienced emotional intensity is likely to increase the extent to which attitudes towards one's assignment and environment can meaningfully influence overall Task and assignment attitudes (Simon, Judge, & Halversen-Ganepola, 2010). Mischel and Shoda (1998) argue that important information is lost when the influence of situational factors, or within-individual variation, is overlooked. According to their model, personality traits, such as *A* can be linked to information processing dynamics (e.g., encodings, beliefs, self-regulatory plans) that are sensitive to situational stimuli; consequently, environmental stress can disturb attentional processes during the tasks.

On the contrary, some researchers have shown different results. Parker, Majeski, & Collin (2004) both the inattention and hyperactivity/impulsivity groups scored significantly lower than the non-ADHD control group on *A*. *A* is related to a variety of antisocial tendencies. For example, high levels of *A* have been linked to reduced anger (e.g., Watson, 2000) and reduced aggression (Gleason, et al., 2004). Individuals high in *A* also make use of more effective conflict resolution strategies (e.g., Jensen-Campbell & Graziano, 2001), and tend to argue less in the course of their everyday lives (Meier & Robinson, 2004). Wilkowski, Robinson, & Meier (2006) found that highly agreeable individuals exhibited difficulties disengaging from prosocial stimuli and levels of *A* were predictive of spatial disengagement costs such that more agreeable individuals appeared to dwell on prosocial stimuli. This bias in allocation of attention leads to tension and stress reduction and is opposed to our findings. These differences may be caused by methodological issues such as sample amounts, control variables, etc. Further studies should be carried on in order to explain these differences.

4.6. The effect of stress on visual selective attention according to Conscientiousness (C)

The results showed that the negative effect of stress on visual selective attention was intensified by high levels of *C* significantly (comparing C experimental group with Original group; p<.014).

Findings about the effects of *C* on performance are varied and to some extent divergent. Nater, Hoppmann, & Klumb (2010) found that individuals with high scores on *C* displayed reductions in daily cortisol concentrations that were driven by positive affect compared to individuals with low *C* scores; thus, it can be concluded that *C* moderates the association between daily positive affect and cortisol. These authors proposed that *C* exerts its positive influence on health via affect-related regulation of HPAA activity. In particular, a hypothesis is individuals with high scores in *C* tend to be more organised regarding their daily life matters and are thus less likely to experience distress by challenging everyday life tasks. These findings suggest a reductive effect of high levels of *C* on stress consequences, unlike ours.

On the other hand, in their recent study, Robert & Cheung (2010) showed that high *C* groups given systematic task instructions, and the low *C* groups given flexible task instructions tended to perform best at the task, and groups given the opposite instructions (i.e., those not activating the traits) tended to perform worse. Besides, *C* can amplify the influence of low-outcome and deficiency in individuals, since people high on this factor are ambitious and goal-oriented and may have suffer high levels of frustration as a result of failure in performing the tasks and entrusted responsibilities (Grant, & Langan-Fox, 2007).

When *C* is analysed in facet level, rather than factor level, this divergence and relative ambiguity of findings can be better understood. In this level of analysis, for example, Giluk (2009) found that *Self-Discipline* (C_5) facet has a positive powerful relation with selective attention; thus, in high conscientious people this facet helps keeping selective attention level in stressful situations. On the contrary, these people, because of high scores in this factor, have high scores in *Deliberation* (C_6) facet too, which means they act just in lines of preset plans, accurately think before performance, do not deviate of the preset programs and are highly vigilant (McCrae, & Allik, 2002; Costa & McCrae, 1992). Hence, it may come to occur that *Deliberation* (C_6) in people with high levels of *C* has neutralized *Self-Discipline* (C_5) effects and may have more potency than *Self-Discipline* (C_5), which leads to amplifying the negative effect of stress on visual selective attention in the given study. This area of study requires more investigations to reach a suitable explanation.

5. Conclusion

The present study explored the moderating roles of the FFM factors on the effect of stress on visual selective attention. The results have been discussed on discussion. In addition, some further results have been achieved amongst the effect size of personality factors. In *Counting Error*, *N* had significantly highest effect followed by *A*, *E*, *C* and *O* respectively. In *Classification Error*, *N* had significantly highest effect and followed by *E*, *A*, *C*, and *O* respectively. Yet, the authors have not founded the reason or explanation of such differences in effect sizes of the FFM factors.

Some results of the present study were different from the literature. These differences may be caused by the wide range of control variables such as handedness, eye dominance, gender, age, educations, etc. In fact, further comprehensive studies are required to make a better understanding of all the aspects of these interesting findings of our study.

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